

Introduction and Background

Purpose The purpose of this manual is to provide developers, contractors, planners and local government officials with information and descriptions of erosion, sediment and stormwater control practices. Use of these practices will reduce the amount of sediment and other pollutants leaving construction sites and entering our water resources. Their use can also reduce stormwater runoff and its potential to carry pollutants, cause flooding and stream channel instability.

The Effects of Urbanization on Water Quality High density human activities, particularly urbanization, alter water drainage patterns and add pollutants to our rivers, lakes and streams. Recent studies by the U.S. Environmental Protection Agency (EPA), state water pollution control agencies and universities show that stormwater runoff is a major source of water pollution. Polluted water runoff endangers bodies of water being used for drinking, household purposes, recreation and fishing.

Soil sediment that leaves the site of construction activity is a large contributor to water pollution. This sediment not only carries soil particles (the major pollutant), but can also carry attached pollutants such as petroleum products, metals, chemicals, pesticides, organic products and bacteria.

Sediment loading rates from construction sites are typically 10 to 20 times greater than pre-construction rates (North Carolina DEHNR, 1993). Over a short period of time, construction sites can contribute more sediment to receiving streams than was previously deposited over several decades.

There are three main reasons why construction activities increase pollutant loads in runoff. First, the volume and rate of runoff are typically increased, providing a larger capacity to transport pollutants to rivers and lakes. Second, the vegetation is removed leaving bare soil that is much more vulnerable to erosion, resulting in sediment moving into receiving waters. The third reason is that some

pollutants such as petroleum products, chemicals from construction materials, metals, etc., are added to the site during construction (U.S. Geologic Survey, Minneapolis, 1982). These pollutants can attach to the soil particles or remain suspended in the stormwater runoff and move off site.

Hydrologic Changes Land development in urban areas causes drastic changes in the local and watershed hydrology. As land is covered with roads, buildings and parking lots, the amount of rainfall that can infiltrate into the soil is reduced. Figure 1.1 shows the reduction in rainfall infiltration into the soil as paved surface and building cover increases. Table 1.1 shows typical percentages of impervious area for different land uses.

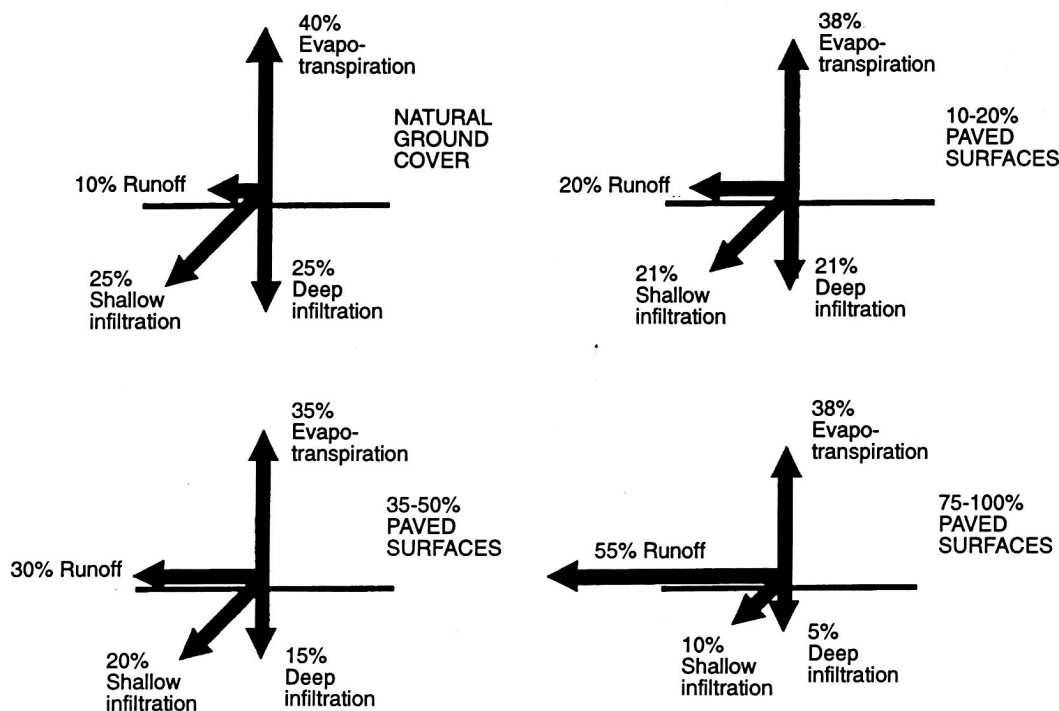
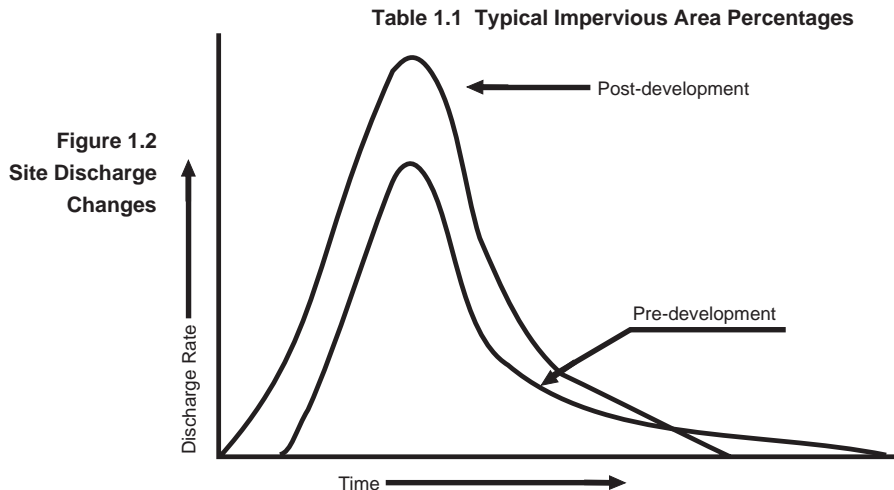


Figure 1.1 Typical changes in runoff flows resulting from paved surfaces
Source: Minnesota "Protecting Water Quality in Urban Areas," 1991

Land Use	% Impervious Cover
Business District or Shopping Center	95 - 100
Residential, High Density	45 - 60
Residential, Medium Density	35 - 45
Residential, Low Density	20 - 40
Open Areas	0 - 10

Source: Minnesota "Protecting Water Quality in Urban Areas," 1991

As land areas are developed, natural drainage patterns are modified as runoff is channeled into road gutters, storm sewers and paved surfaces. These changes concentrate the volume of runoff in drainageways and increase the speed of flow. This results in higher peak discharges and shorter times to reach peak discharge. Figure 1.2 shows typical pre-development and post-development discharge rates versus elapsed time for a site being developed for urban land use. The area under the curves represents the volume discharged. The increased volume and discharge rate shows how the discharge from the site is increased. Flooding and/or soil erosion problems often occur after an area has been developed



Source: Adapted from Minnesota "Protecting Water Quality in Urban Areas," 1991

Another hydrologic effect of urbanization is reduced stream flow during periods of low rainfall. This occurs because paved surfaces do not allow infiltration or retain the water in the soil that would naturally feed the streams. The result is deterioration of the aquatic ecosystem because of high pollutant loadings and low flow during periods of low rainfall.

During periods of high rainfall, the increased discharge rate and downstream flow often cause channel and streambank erosion in the receiving stream.

Removal of vegetation prior to construction activity is a major contributor to sediment moving off site and entering nearby streams and lakes. Bare soil is highly vulnerable to erosion. Sediment movement from construction sites can range up to 1100 tons/acre/year (EPA, 1977). Vegetative cover is the most effective control of erosion and sediment loadings.

Urban Nonpoint Source Pollution The major nonpoint source pollutants (See *Glossary*) in urban areas include sediments, nutrients, petroleum products, chemicals and metals, pesticides, fertilizers and other potentially toxic chemicals (Minnesota DPCA, 1991).

Sediment Sediment from soil erosion is made up of soil particles and gravel that are washed into rivers, lakes and streams. It is the major pollutant in surface waters. Excessive sediment in waterbodies impairs aquatic ecosystems, reduces public water storage and increases drinking water treatment costs. These sediment particles also are a vehicle to transport other pollutants including nutrients, metals, petroleum products and bacteria to surface waters.

Runoff from construction sites is the major source of sediment in urban areas under development. Typical sediment loading rates from construction sites vary from 100 to 200 tons/acre/year (North Carolina DEHNR, 1993). Another major source of sediment is off-site streambank erosion which is increased by the higher peak runoff flow rates and volumes previously discussed.

Nutrients Phosphorus and nitrogen are the primary nutrients causing water pollution. Household detergents and lawn fertilizers are the major sources of phosphorus. Nitrogen comes from fertilizer, too, but is also found in animal wastes, grass clippings and effluent from leaky septic systems.

Phosphorus and nitrogen are sources of food for the algae and bacteria that live in lakes, streams and rivers. Waters polluted with these nutrients develop large numbers of algae and bacteria that use up oxygen, causing fish and other beneficial organisms to die. Nitrates in drinking water are responsible for the “blue baby syndrome” that has caused illness and deaths in infants and have been linked to certain forms of cancer in adults (Health and Environment Digest, 1988).

Nutrient pollution can be prevented by using phosphate-free detergents, composting grass clippings and animal wastes, and repairing leaky septic systems. The most effective means of controlling nutrient pollution on the construction site is to apply fertilizer at the rate recommended by a soil test.

Petroleum Products Petroleum products float on water and are visible. The hydrocarbons in petroleum have a strong characteristic for attaching to sediment particles. Hydrocarbons are known to be toxic to aquatic organisms. Common sources of petroleum products at the construction site are oil storage, fuel facilities, leaks from crankcases and improper disposal of drain oil.

Chemicals Paints, solvents, sealants, cleaning agents and caulks may be found on construction sites. These chemicals along with chemically composed or treated construction materials may enter the runoff water. Water quality is degraded and removal during water treatment processes may be very expensive.

Metals Trace metals including lead, zinc, copper, chromium, cadmium and nickel are found on construction sites. In high concentration these metals are toxic to aquatic life. They originate from building materials, vehicle emissions and road sand/salt. Studies have shown that trace metals bioaccumulate in plants and aquatic life in areas where they are contained in sediment.

Current Legislation The large increase in land development in the rapidly urbanizing areas has caused serious erosion, sedimentation and stormwater runoff problems. Erosion, sedimentation and stormwater runoff control is governed by federal, state and local regulations. The statutes currently in force are:

Federal The federal Clean Water Act of 1972 and additions in 1987 established certain water pollution control regulations and permit requirements. This program is called the National Pollutant Discharge Elimination System (NPDES). The enforcement of these regulations and issuance of permits was delegated to the Missouri Department of Natural Resources in Missouri. In Kansas, enforcement and issuance of permits was delegated to the Kansas Department of Health and Environment.

The U.S. Army Corps of Engineers governs the placing of dredge or fill material in waterbodies and the destruction of wetland areas.

State The Missouri Department of Natural Resources (MDNR) and the Kansas Department of Health and Environment regulate the quality of stormwater runoff by requiring a permit. The regulations address pollution in rainwater runoff that is discharged from certain industrial sites, construction sites disturbing an area of five acres or more and urban storm sewers.

The five acres include all land disturbance activities that are part of a common plan or sale. The law applies to total land area disturbed over the life of the project. Land disturbance activities that were started prior to the 1992 passage of the regulations may still require a permit if the site has not been stabilized. Kansas and Missouri (10 CSR 20-6.200) regulations should be consulted for specific requirements.

Missouri Permit Requirements General Permit Requirements: Contractors who are developing land within Missouri need to apply for a permit, which will be issued under one of the following four permit categories. Permit applications should include a plan indicating how erosion, sedimentation and stormwater will be controlled on the site.

- 1) Land disturbance activities that impact over five acres and that are **performed by (or under contract to) a city, county or state government agency** with a stormwater control program approved by the MDNR. The local government should apply to MDNR.

- 2) Land disturbance activities that impact five acres or more and that are **performed by the private sector in a city or county with a stormwater control program** approved by the Department of Natural Resources.

Apply first to your local authorities, usually the city or county planning or engineering department, for their permit requirements. Then submit a copy of the local permit or approval letter with your application to MDNR. Some local authorities will send your application and/or the approval letter directly to MDNR. Sampling is not required unless specified in the local plan.

- 3) Land disturbance activities that impact five acres or more and are **not covered by the permits described above**.

Apply directly to MDNR. The permit requires that a Stormwater Pollution Prevention Plan (SWPP) be developed before any site vegetation is removed or disturbed, and before a permit can be issued. The SWPP requires that the permittee use best management practices on site to reduce the amount of sediment and other pollutants in the stormwater associated with the land disturbance activities.

- 4) Land disturbance activities that impact five acres or more **near valuable water resources of the state. These areas are:**
- within 1,000 feet of a lake used primarily as a public drinking water supply,
 - outstanding resource waters, such as cold water trout streams,
 - lakes participating in EPA's "Clean Lakes Program," or within 100 feet of major reservoirs or permanent streams (except the Missouri and Mississippi Rivers); and
 - sinkholes, losing streams or other direct conduits to groundwater.

If more than one acre of the land disturbed is defined as a wetland, then proof of approval granted by the U.S. Corps of Engineers (404

permit) should be submitted with the application.

Contact MDNR for a permit and more information on protected water resources. The permit also contains the same SWPP requirements as the previous category. The termination dates for these permits is January 2, 2002.

State Fees and Permits **Fees and Application Form:** To obtain current application forms and fee information, call or write to:

Missouri Department of Natural Resources
Division of Environmental Quality
Water Pollution Control Program, Permits Section
P.O. Box 176
Jefferson City, MO 65102
1-800-334-6946 or 573-751-6825

Kansas Department of Health and Environment
Bureau of Water
Building 283, Forbes Field
Topeka, KS 66620
913-296-5557

Local Some county and municipal governments have regulations and ordinances in force to control erosion, sedimentation and detention of stormwater runoff at construction sites. Some define and describe best management practices, but each differ in detail and permitting requirements. Before starting a site development plan, contact the local county or municipal engineer or planning and zoning office. Conformance with a city or county ordinance or plan does not exempt the construction activities from state permit regulations.

The local Soil and Water Conservation District and the United States Natural Resources Conservation Service office can provide information on local requirements and provide technical assistance. Most of these offices also have a soil survey that provides information on soils in the county and their limitations.

Another source of information, particularly for turf establishment, is University Extension.